SEVEN

ACCESS AND HAZARD CONTROLS

7.1 BACKGROUND

Access and hazard controls eliminate or control worker exposure to hazards, facilitate work activities, and prevent site access by unauthorized personnel. Specific control measures are developed early in the planning stages of the project, specified in the health and safety plan (HASP), and modified based on new information as the project progresses. The "tool box" of access and hazard controls includes the following hierarchical site control measures (see Figure 7-1):

Engineering controls;
Administrative controls; and
Personal protective equipment (PPE).

> "Access controls can be effectively used to manage the scope and application of the Hazardous Waste and Emergency Response (HAZWOPER) Standard and are easily applied to hazardous waste projects."

Engineering controls are considered first and preclude worker exposure by removing or isolating the hazard. Administrative controls are considered second and eliminate or control exposure by (1) managing worker access to hazards or (2) establishing safe work procedures. Whenever engineering or administrative controls are not feasible, PPE to control the degree of worker exposure and allow direct access to hazardous operations or locations is used. Table 7-1 provides examples and advantages and disadvantages of common access and hazard controls, which are discussed in greater detail in the text that follows.

It is recommended that the multidisciplinary team (see Chapter 3), which includes workers, develop the access and hazard control strategy for each hazardous waste operation and activity. Hazardous waste projects are conducted optimally by applying a combination of control measures. The degree of control necessary depends on the site characteristics and size, the actual and potential hazards, the nature of the work, the adjacent occupancy, and the surrounding community (see Figure 7-2). Site controls maintain worker protection consistent with cost-effectiveness and efficiency in completing work. Site control strategies applicable to both radiological and hazardous waste operations are to be integrated. Site control concepts specified in 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" (the HAZWOPER Standard); 10 CFR 835; and the *Draft DOE Radiological Control Technical Standard* are compatible and consistent, differing only in nomenclature.

7.2 USING ACCESS AND HAZARD CONTROLS TO MANAGE SCOPE

As discussed in Chapter 2, worker exposure to hazards resulting from hazardous waste operations is one criterion for determining whether an operation or location falls under the regulatory scope of HAZWOPER. When determining regulatory scope, exposure has two elements—the presence of a hazard and worker access to the hazard. Either eliminating the hazard or worker access to the hazard often means that an operation or location does not fall under HAZWOPER.

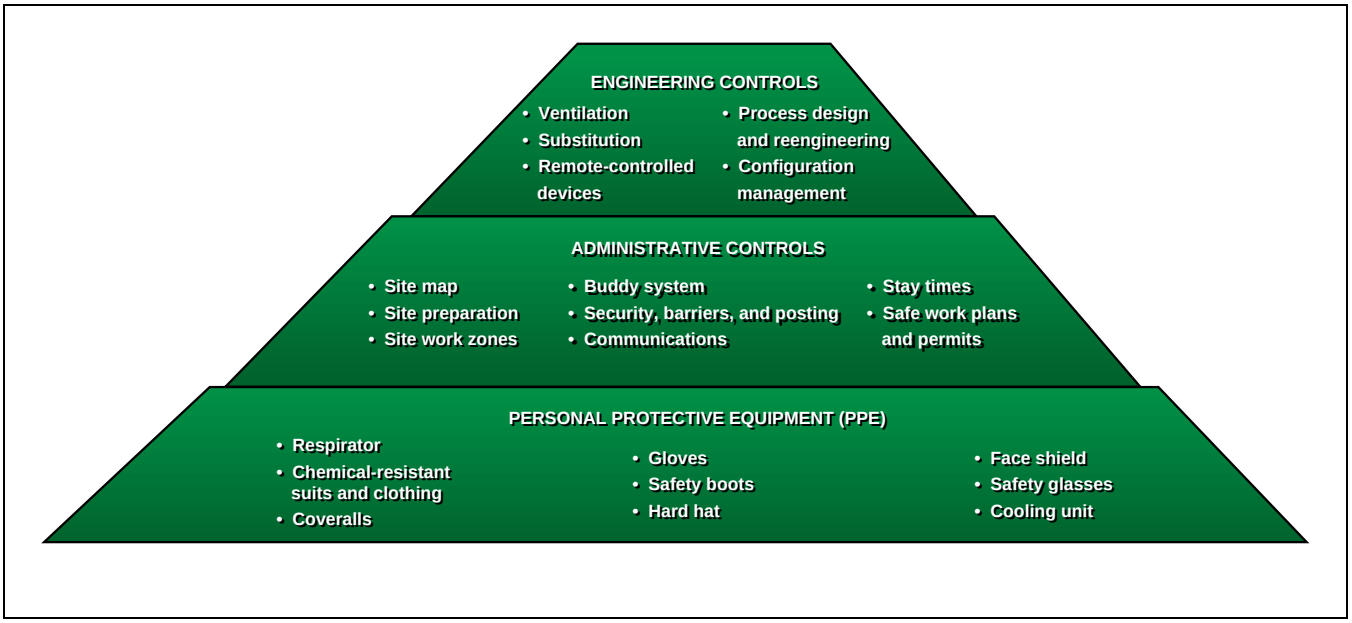

Figure 7-1. Hazard Control Hierarchy

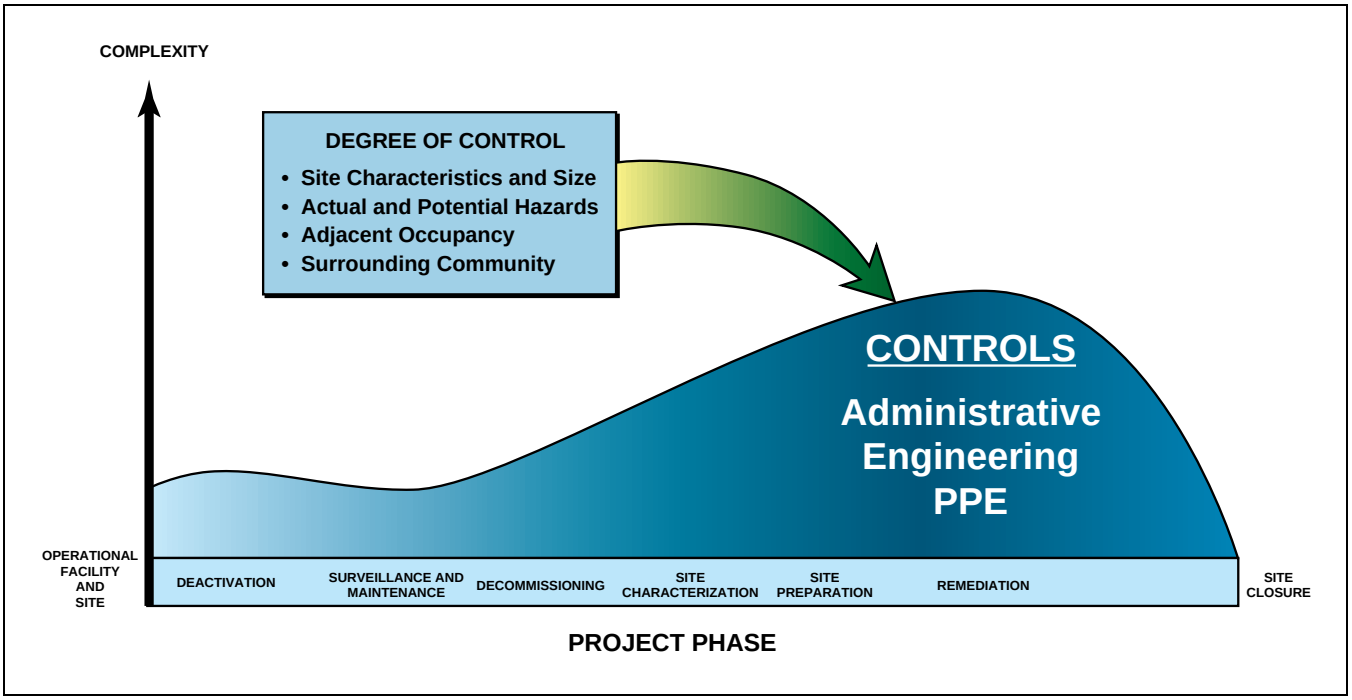

Figure 7-2. Access and Hazard Control Complexity

Engineering controls remove or isolate the hazard. While engineering controls can generally be readily applied to deactivation and decommissioning projects, they are difficult to apply to most hazardous waste projects since removal of hazardous waste is almost always an "after-the-fact" proposition. Using engineering controls to manage the scope and application of HAZWOPER is usually limited to localized areas and tasks as illustrated by Example 2-2 (Chapter 2). Access controls effectively manage the scope and application of HAZWOPER and are easily applied to hazardous waste projects (see Examples 2-1 and 2-4 in Chapter 2). PPE cannot be used to manage scope; workers who wear PPE fall under the HAZWOPER Standard when involved with hazardous waste work. Example 7-2 illustrates using a combination of controls to maintain worker safety consistent with optimizing the scope of HAZWOPER.

Table 7-1. Summary of Access and Hazard Control Measures

Control	Examples	Potential Advantages	Potential Disadvantages
Engineering • Precludes worker exposure by removing or isolating the hazard	• Ventilation • Substitution • Remote-controlled devices • Process design and reengineering • Configuration management	• Most protective of worker health and safety • Limits scope and application of health and safety standards • Reduces specialized training requirements • Does not require frequent professional health and safety coverage • Eliminates PPE use • Expedites work by reducing delays from decreased worker efficiency	• May be costly • Requires time to implement • Permanent solution that may be impractical for hazardous waste activities
Administrative • Eliminates or controls worker exposure by (1) managing access to hazards or (2) establishing safe work procedures	• Site map and site preparation • Site work zones • Stay times • Buddy system • Security, barriers, and posting • Communications • Safe work plans and permits (including radiological work permits [RWPs])	• Limits scope and application of health and safety standards • Reduces specialized training requirements • Eliminates PPE use • Expedites work by reducing delays from decreased worker efficiency • Standardizes and optimizes work procedures	• May impose additional health and safety requirements • Requires professional health and safety coverage
Personal Protective Equipment • Controls degree of worker exposure	• Respiratory protection • Protective clothing • Head, eye, hand, and foot protection • Additional protection (e.g., hearing)	• Workers have direct access to worksite and hazard • Expedites quick entry and response	• Increases worker exposure to hazard • Reduces worker efficiency • Requires professional health and safety coverage • Requires specialized training and certifications • Generates waste

7.3 ENGINEERING CONTROLS

Engineering controls preclude worker exposure by removing or isolating the hazard and should be considered first. A cost benefit analysis determines the advisability of selecting engineering controls. Table 7-1 lists some trade-offs when considering engineering controls.

VENTILATION

Ventilation is either local or general in nature and controls exposure by exhausting or supplying air. Local ventilation directs air movement; general ventilation dilutes the air. Ventilation generally has limited use in uncontrolled hazardous waste work, but there are some applications. Fans can be used to direct contaminants away from drilling operations, which may reduce or eliminate the need for respiratory protection. A particularly good application is to air rotary drilling, which tends to blow contaminants out of the borehole and into the air; fans can then significantly reduce worker exposure. Confined-space entry nearly always requires some form of exhaust ventilation to control explosive and toxic hazards. Lastly, a specialized application is the use of pressurized cabs or control booths on heavy equipment, which can help reduce heat and cold stress as well as exposure to contaminants.

SUBSTITUTION

Example 7-1 is an excellent illustration of applied engineering controls. Substitution replaces a hazard with a less hazardous alternative.

REMOTE-CONTROLLED DEVICES

Devices that are controlled remotely have been increasingly applied to hazardous waste work. Common techniques include use of pneumatically operated impact wrenches to open drum bungs and hydraulic and pneumatic piercers for penetrating drum tops. Remote monitoring well sampling devices can dramatically reduce the need for respiratory protection during well development and sampling.

PROCESS DESIGN AND REENGINEERING

The greatest application of process design and reengineering is to operational facilities undergoing deactivation and surveillance and maintenance. The earlier that safety is considered in the design process, the less it costs to implement and the greater the chance for *inherent safety* (i.e., the potential dangers have been removed). However, for existing facilities, safety considerations are manifested *extrinsically* (e.g., safety is added with devices such as alarms and interlocks and practices such as equipment redundancy).

Less Hazardous <> More Hazardous

Health
Neutral cleaners <> Acidic cleaners
Neutral cleaners <> Alkaline cleaners
Water-based cleaners <> Solvent cleaners
Water <> Organic solvents
Nonchlorinated solvents <> Chlorinated solvents
Ozonation <> Chlorinated solvents
Scabbling <> Solvent or sandblasting
Water-based paints <> Lead-based paints
Water-based paints <> Oil-based paints
Bioremediation <> Soil excavation
Fiberglass insulation <> Asbestos insulation

Safety
Daylight operations <> Nighttime operations
Handcarts <> Hand carrying
Grounded electrical <> Ungrounded electrical
Safety cans <> Bottles
Safety glass <> Regular glass
Side-shield glasses <> Regular glasses
"Cherry-picker" <> Ladder

Example 7-1. Substitution

CONFIGURATION MANAGEMENT

Configuration management refers to designing the work area for maximum safety and efficiency. It should be carefully considered when installing engineering controls so that overall safety systems are not adversely impacted.

7.4 ADMINISTRATIVE CONTROLS

Administrative controls eliminate or control exposure by (1) managing worker access to hazards or (2) establishing safe work procedures. Table 7-1 lists some advantages and disadvantages of administrative controls. The sequence depicted in Example 7-2 can be used as a general framework for establishing administrative control measures.

SITE MAPS

Site maps are required by the HAZWOPER Standard and show site work zones; topographic features and predominant wind direction; buildings, tanks, impoundments, pits, ponds, and other structures; and the locations of specific safety, health, and radiological hazards. Overlays provide the necessary information without cluttering the map or making it illegible. Maps are posted at access control points and are updated to reflect changes in work scope, jobs and tasks, and new hazards.

- Compile a site map.
- Determine site preparation requirements.
- Define the site work zones.
- Determine stay times.
- Organize the buddy system.
- Establish decontamination procedures (see Chapter 8).
- Determine security, barrier, and posting requirements.
- Specify communications systems.
- Establish safe work plans and permits (including RWPs).

Example 7-2. Establishing Administrative Controls

SITE PREPARATION

Site preparation is crucial in establishing access and hazard controls and is carefully integrated with the work plan. It defines major access routes and patterns and involves applying engineering controls to remove or isolate hazards to reduce the need for administrative controls and PPE. The text box below outlines a strategy.

Site Preparation Strategy

- Plan traffic flow patterns to facilitate efficient operations.
- Design and construct roadways to provide ease of access and a sound roadbed for heavy equipment and vehicles.
- Design and construct loading docks, processing and staging areas, and operations and decontamination pads.

Apply controls to eliminate hazards in work areas:

- Eliminate ignition sources in flammable hazard areas.
- Remove or repair ungrounded electrical wiring and low overhead wiring that may entangle equipment.
- Remove sharp objects and debris, such as glass, nails, and torn metal, which could puncture PPE.
- Repair holes, loose steps or flooring, or unsecured railings, which can cause falls, slips, and trips.
- Secure unsecured objects on elevated surfaces (e.g., catwalks, rooftops, and scaffolding) which could fall.
- Remove weeds that obstruct visibility.
- Install skid-resistant strips on slippery surfaces.
- Provide adequate illumination.

SITE WORK ZONES

Site work zones are required by the HAZWOPER Standard. Hazardous waste sites are divided into as many or as few zones as needed to meet operational requirements and to protect worker health and safety. Work zones are designed to control access to actual and anticipated hazards. 10 CFR 835 is prescriptive in the types of work zones necessary to control radiological hazards and the 10 CFR 835 Implementation Guides and the *Draft DOE Radiological Control Technical Standard* provide guidance for their establishment; however, radiological work zones closely parallel and are compatible with hazardous waste work zones (see Table 7-2). Work zones integrate radiological and nonradiological protection requirements. Work zone positioning is based on hazard characterization and exposure assessment. Anticipated operations, potential releases, and the amount of contaminant dispersion are important for delineating these zones. Figure 7-3 illustrates the basic site work zones.

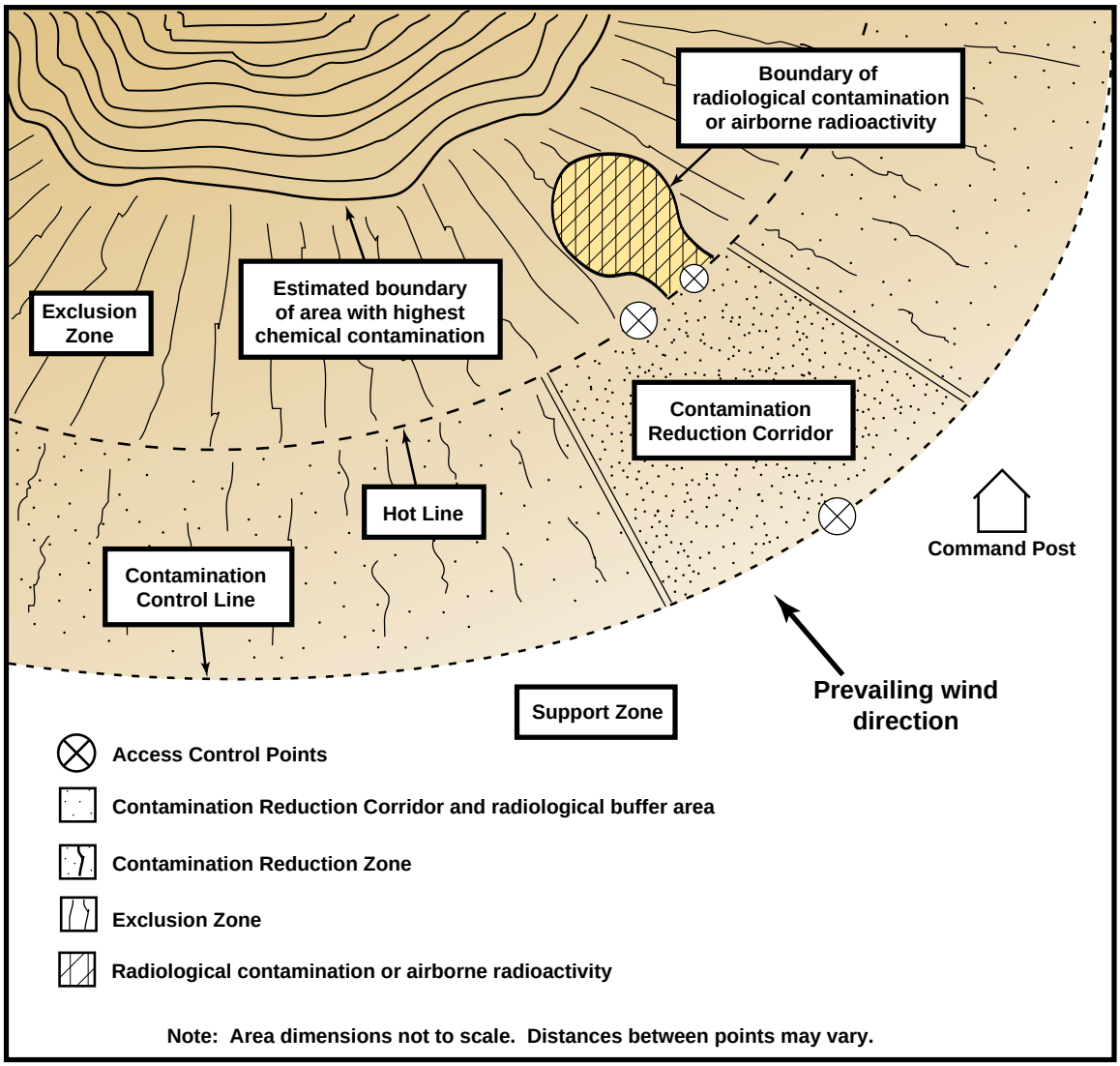

Figure 7-3. Site Work Zones

Table 7-2. HAZWOPER and Radiological Work Zones

HAZWOPER Term	Radiological Term
Contamination Control Line	Controlled Area Boundary
Exclusion Zone	Radiologically Controlled Area
Nonradiological (Chemical) Hazard Areas Within Exclusion Zone	Contamination Area or Radiation Area
Contamination Reduction Zone	Radiological Buffer Area

Exclusion Zone. The exclusion zone is where contamination is present and the highest possibility for worker exposure to hazardous waste occurs. The HASP specifies PPE requirements for work conducted within the exclusion zone. Without exception, workers who enter the exclusion zone wear specified PPE. The level of protection (see Section 7.6) may vary within the exclusion zone based on activity, stage of the operation, or location, which allows for flexibility in operations and resources. For instance, most of the exclusion zone, as defined by the "Hot Line" (the exclusion zone boundary—see the text box at right), might have a relatively low exposure potential that could be controlled by Level D PPE; an area undergoing subsurface remediation within the zone might be set apart and controlled by Level B PPE; and another area might contain surface chemical contamination and require Level C PPE. This is comparable to a radiological area within a controlled area containing several "radiation areas," "high radiation areas," "very high radiation areas," "contamination areas," "high contamination areas," or "airborne radioactivity areas."

Access control points are established at the Hot Line to regulate the flow of personnel and equipment into and out of the zone. Separate entrances and exits are provided for personnel and heavy equipment.

Establishing the "Hot Line"

- Visually survey the environs of the worksite.
- Determine the locations of the hazardous waste and substances; drainage, leachate, and spilled material; and visible discolorations.
- Evaluate the initial direct reading instrument survey data for the presence of combustible gases; organic and inorganic gases, particulates, or vapors; and ionizing radiation.
- Evaluate air, soil, and water sampling results.
- Consider the distances needed to prevent an explosion or fire from affecting personnel outside the exclusion zone.
- Consider the area necessary for site work to reduce the spread of contamination.
- Consider meteorological conditions and the potential for contaminants to be blown from the area.
- Secure the Hot Line using appropriate barriers and posting.
- Modify the Hot Line location, if necessary, as more information becomes available.

Contamination Reduction Zone/Corridor (CRZ/C). The CRZ/C is where decontamination (see Chapter 8) is conducted and is the entry and egress route between the exclusion and support zones. The CRZ/C reduces the probability that the clean area or support zone becomes contaminated or otherwise affected by site hazards by limiting the transfer of hazardous substances. This concept is analogous to the radiological buffer area. The contamination control line sets the boundary between the CRZ/C and the support zone and is comparable to the controlled area boundary designated for radiological controls. With the exception of decontamination workers, the CRZ/C is positioned and maintained in a condition that requires minimal use of PPE. While this is true, decontamination workers wear PPE appropriate to the hazard. The level of PPE required in the CRZ/C is specified in the HASP. The CRZ/C design must facilitate:

- Personnel and equipment decontamination (e.g., separate lines for workers and heavy equipment such as tractors, earth-moving equipment, and trucks);

- Emergency response functions (including transport of injured personnel, first-aid equipment, and containment equipment);
- Equipment resupply;
- Sample packaging and preparation for onsite or offsite laboratories;
- Location of worker temporary rest areas;
- Drainage of water and other liquids used in the decontamination process;
- Waste minimization; and
- Reduction or elimination of mixed waste production.

Establishing the CRZ/C and Buffer Zone

The CRZ/C's primary purpose is to keep the support zone free of contaminants and hazards. The size and location of the CRZ/C should be based on the stability of worksite conditions, the potential for dispersion of contaminants and for unexpected events, and the proximity of uninvolved workers and third parties. The CRZ/C boundaries are established based on hazard characterization and do not need to encircle the entire perimeter of the exclusion zone when work:

- Involves only Level D PPE and exposure to and disturbance of contaminants is unlikely;
- Is small scale or of limited duration (e.g., preliminary site investigation lasting only a few hours or days);
- Is remote and secured from peripheral occupancy and traffic;
- Is controlled according to 10 CFR 835 work zone criteria and guidance provided in the 10 CFR 835 Implementation Guides and the *Draft DOE Radiological Control Technical Standard* and does not involve inactive or secured contamination areas; and
- Does not involve the spread of radiological contamination.

Support Zone. The support zone is a clean area where administrative and support functions necessary to maintain effective operations within the exclusion zone and the CRZ/C are located. The support zone location should be based on six general criteria (see text box, right): accessibility, resources, visibility, prevailing wind direction, distance from exclusion zone, and type of work. Normal work clothes are appropriate for the support zone. PPE worn for the hazardous waste work remains in the CRZ/C, where it is decontaminated or packaged for transport and disposal or decontamination.

Location of the Support Zone

- Accessibility — close proximity to highways and railroad tracks; easy access for emergency vehicles; sufficient open space available; and favorable topography.
- Resources — ample roads, power, telephones, shelter, and water.
- Visibility — line of sight to exclusion and CRZ/C zones.
- Prevailing wind direction — upwind of the exclusion zone.
- Distance — as far as practical from the exclusion zone.
- Type of work.

Separate support zone facilities may not be needed where site facilities are readily available and near to the worksite, and if close communication is maintained. For multiple hazardous waste operations conducted in close proximity, it is possible to design one support zone to serve several operations. Depending on the scope of the project, a

properly equipped support zone may consist of a single trailer or may be composed of multiple facilities such as a command post, medical station, equipment and supply centers, field laboratory, and administrative areas.

Worker Comfort Areas. Worker comfort areas are located within site work zones to allow workers to take breaks and rest. These areas are designed to maintain the safety of workers and generally require special procedures for ingress and egress, personnel and air monitoring, potable water consumption, and restroom use.

Temporary Site Work Zones. Work zones may be temporary. The work is planned; the zones and containments are established; the work is conducted; and the zones are dismantled. As illustrated by Example 7-3, temporary work zones can be used to effectively manage regulatory scope. Area and personnel exposure monitoring is crucial in order to verify that zoning, containments, work practices, and procedures have been designed appropriately and maintain worker health and safety.

A plumber is needed inside an exclusion zone to repair a water pipe that has burst. There are three options:

Engineering controls: The entire exclusion zone is decontaminated (e.g., hazardous wastes and substances are removed) so that the plumber does not fall under the scope of HAZWOPER and require specialized training or PPE other than that required to safely repair the pipe. Depending on the actual work location, the work may fall under the scope of other health and safety standards of practice (e.g., the Confined-Space-Entry Standard if the work is in a confined space).

Engineering and administrative controls: A competent person determines that the immediate work area and an access corridor can be decontaminated such that there is no exposure to hazardous waste operations. Barriers to contaminated areas are established so that the plumber can transit the clean corridor and repair the pipe in the decontaminated area. In effect, the immediate work area and access corridor become a temporary support zone. No specialized HAZWOPER training or PPE would be required (other than that required to safely repair the pipe). The work may fall under the scope of other standards of practice.

PPE: After medical certification, respirator fit-testing, and specialized HAZWOPER training, as required by health and safety procedures established in the HASP, the plumber dons appropriate PPE, enters the exclusion zone, and repairs the pipe. The work may also fall under the scope of other standards of practice.

The health and safety of the plumber is maintained in all three options. Completely decontaminating the entire exclusion zone eliminates exposure to the hazardous waste or substances, but generally is impractical and costly. Decontaminating the immediate work area and establishing a clean corridor is probably the method of choice, but needs careful evaluation by a competent person. PPE use is also costly due to the need for medical certification and HAZWOPER training, but allows the work to proceed without delays. PPE also reduces worker efficiency and poses a hazard in itself. In all three options, the task may be covered by additional worker protection standards due to the nature and location of the work.

Example 7-3. Using Access and Hazard Controls to Manage Scope

STAY TIME

Stay time is the amount of time a worker is allowed in a hazardous area. Stay times are developed before work in hazardous and radiological areas begins and are a factor in determining the number of qualified workers, the total amount of time, and the cost to complete the work. A key factor in limiting work duration relates to PPE usage and includes air supply consumption, suit and ensemble permeation and penetration by chemical contaminants, ambient temperature ranges, coolant supply, visibility, and mobility. Total radiation exposure is also a consideration. For example, if radiation levels are 200 mrem/hour and exposure is to be limited to 100 mrem, workers can work in the area for only 30 minutes.

THE BUDDY SYSTEM

No one should enter a contaminated area or an exclusion zone without a "buddy" who is capable of:

- Providing the partner with assistance;

"One of the most important tenets for any type of work around hazardous materials is never work alone."

- Observing the partner for signs of adverse exposure to chemical, physical, or radiological hazards, and notifying the appropriate persons if emergency help is needed; and

- Periodically checking the integrity of safety systems and the partner's PPE and other safety equipment.

The HASP specifies tasks requiring the buddy system. Examples include:

- Exclusion zone or confined-space-entry;

- Entry into a high contamination area, very high contamination area, or high radiation area as defined in 10 CFR 835 and the *Draft DOE Radiological Control Technical Standard*;

- Performance of any task in any area requiring PPE greater than Level D; and

- Work in areas of significant hazards (e.g., work around highly energized circuits or in excavations).

The buddy system should be balanced against the need to maintain radiation or carcinogen exposures as low as reasonably achievable (ALARA), and the need to keep workers removed from hazards. Buddies should be positioned at some distance from the hazard to minimize their exposure while preserving communication and line-of-sight contact with the command post supervisor or designee. Buddies do not have to be positioned in the exclusion zone. Rather, they can be positioned in the CRZ/C, which facilitates compliance with the buddy system and reduces risk to the buddy, while still allowing access when the need arises. The buddy system alone may not be sufficient to ensure that help will be provided in an emergency. At all times, workers in the exclusion zone should be in line-of-sight contact or communications contact with the command post supervisor or backup person in the support zone.

The work authorization system (e.g., radiological work or safe work permits) and pre-job briefings are crucial for specifying application of the buddy system and designation of buddies. Work permits may also be used to specify mandatory participation by health physics personnel and health and safety professionals, either in the buddy system or in support and oversight of the work.

SECURITY, BARRIERS, AND POSTING

Security, barriers, and posting limit worker and third party access to the worksite and to site hazards and work zones. Security measures for hazardous waste activities exceed those required for general access and egress and prevent:

- Exposure of unauthorized, unprotected personnel to worksite hazards;

- Spread of contamination;

- Access by thieves, vandals, or persons seeking to abandon other wastes on the worksite; and

- Interference with safe working procedures.

Site security can be maintained during off-hours by assigning trained in-house technicians for surveillance, using security guards to patrol the worksite boundary, enlisting public agency enforcement (if the worksite presents a significant public health and safety risk), and securing equipment.

Security Measures

- Erect a fence or other barrier around the worksite.

- Have guards patrol the perimeter and post boundary signs, if the worksite cannot be fenced in.

- Establish a system to identify authorized entrants and to validate certifications and credentials. Make certain all entrants have a valid purpose for entering the site. Make certain visitors are accompanied.

- Assign enforcement authority for entry and exit control.

- Coordinate security procedures with any affected public enforcement agencies.

- Maintain security in the support zone and at access control points.

Barrier selection depends on the type of health and safety hazards posed by the worksite and ongoing work, the amount of traffic and occupancy near the site, and the duration and stability of operations. Chain-link fencing is the preferred means of securing the overall site or large work zones. Other types of fencing, stakes, rope, and tape lines may be used for delineating smaller sites or work zones. For indoor deactivation and decommissioning, the building in which the operations are conducted usually provides the principal physical barrier with interior space segregation and posting, although a perimeter fenceline is advisable. Specialized barriers are required for high radiation and very high radiation areas, as is containment for operations involving certain nonradiological operations (e.g., asbestos abatement). If existing structures do not adequately contain these hazards, temporary containments are used.

Physically identifying and posting site work zones and hazards are important elements of worksite hazard communication. Posting requirements are provided in the HAZWOPER Standard, other Occupational Safety and Health Administration (OSHA) standards (e.g., 1910.1000 series and 1910.1926), 10 CFR 835, and various Environmental Protection Agency (EPA) standards. Site work zones are to be clearly identified with signs at the entrance of each work zone. There are specific hazard posting requirements for radiation, confined spaces, asbestos, noise, polychlorinated biphenyls (PCBs), lead, carcinogens, and satellite accumulation areas for hazardous waste storage. Signs are to be securely affixed, resist adverse environmental conditions, and reflect changing conditions and hazards at the worksite.

Signs are spaced to ensure visibility upon approach to the boundary of a work zone or a hazard. At least one sign is to be visible on each side of the boundary and from each direction of approach. Work zone and hazard posting should:

- Identify all radiological and nonradiological hazards and other types of hazards sufficient to maintain worker recognition and safety;
- Be installed immediately after the work zones are established and the hazards are identified; and
- Be clear and minimize confusion when more than one radiological or hazardous condition is present.

Integration of Posting

Radiological and nonradiological work zone and hazard posting can be integrated or placed side-by-side. Integrated posting is the preferred approach at the following locations:

- Contamination control line and controlled area boundary;
- Access control points to the CRZ/C, the exclusion zone, and the radiation and contamination areas; and
- Interior areas at specific locations where radiological and nonradiological hazards coexist.

Integration of worksite posting enhances hazard communication and reduces cost. For example, an integrated posting at the CRZ/C boundary with the potential for radiological and mercury hazards would read "Caution, Radiological and Mercury Hazard Buffer Area." This integrated posting communicates the hazards and satisfies both 10 CFR 835 and HAZWOPER requirements. Additional guidance on these issues may be found in the 10 CFR 835 Implementation Guides and the *Draft DOE Radiological Control Technical Standard*.

COMMUNICATION

Communication at a hazardous waste operation is either internal or external. *Internal communication* is between workers at the various work zones and is used to:

- Alert workers to newly identified hazards or emergencies;
- Provide safety guidance, such as lessons learned or amount of air left;
- Monitor or confirm well-being or exposure, stress, or confusion; and
- Maintain site control and facilitate stop-work actions or worksite evacuation.

Verbal communication can be impeded by background noise from heavy equipment or by PPE. Thus, for effective communication, commands are prearranged and include both visual and verbal cues. A primary and back-up communication system is necessary; both should be checked daily. All communication devices must be spark-free. Communication equipment is coordinated with explosive experts if explosives are used at the site. Individual workers should be identified by names placed on their PPE, or by color-coding or numbers. Communication between heavy-equipment operators in enclosed cabs and workers on foot is critical.

Communication Techniques

- Establish hand signals or visual signals such as flags and lights for workers wearing respirators which interfere with voice communication.
- Use noise-amplifying devices such as megaphones, sirens, whistles, or air horns for small sites or operations.
- At large sites, use walkie-talkies or portable radios as the primary communication between buddies or workers and the command post.
- Use dedicated radio frequencies for emergencies.

External communication is between onsite and offsite personnel and is used to:

- Coordinate emergency response; and
- Maintain contact with outside personnel such as management.

Telephone and radio are the primary means of external communication. If telephone lines are not installed at a site, all team members must be made aware of the location of the nearest telephone. Where mobile telephones are not available or in use, correct change and necessary telephone numbers are to be readily available in the support zone.

SAFE WORK PLANS AND PERMITS

Safe work plans and permits should be developed by a multidisciplinary team, thoroughly evaluated prior to implementation, monitored during use, and modified as conditions change. Conducting work under safe work plans and permits with trained workers dramatically improves worker protection and timely completion of work activities. Written operating procedures are integrated with safe work and radiation plans and permits to identify where additional health and safety expertise is needed prior to the initiation of work.

Safe Work Plans

Safe work plans address both safety and operational needs. The plans identify the work team, assign responsibilities, discuss hazards, delineate special training, and prescribe health and safety requirements. The plans summarize operational procedures, define health and safety coverage, specify monitoring, and address other issues as required. For general hazardous waste work, a combination of the work plan and the HASP can be used, sometimes with modification, to provide safe work plans and/or permits.

The safe work permit defines health and safety hold points and delineates whether site safety and health officer (SSHO) coverage is required. Typical hold points include: monitoring air quality before entering an area; inspecting rigging equipment before conducting a lift; conducting a field briefing or providing special training before proceeding with a task or phase of a task; inspecting an engineering or administrative control and verifying its effectiveness before proceeding with work; and verifying isolation of an energy source (e.g., verifying electrical lockout). Radiation work is often conducted under RWPs, as specified in 10 CFR 835 and in the 10 CFR 835 Implementation Guides and the *Draft DOE Radiological Control Technical Standard*, which have similar types of hold points such as conducting monitoring and verifying and validating installations of temporary shielding. A generic work permit can often be used to extend the use of the safe work permit or RWP beyond a specific task.

The safe work plan supplements the HASP and is an extension of the safe work permit. It addresses hazardous tasks that require a higher standard of care. Activities that typically require a safe work plan are: beryllium decontamination; excavation of highly toxic soils, tanks, or drums; work in potentially explosive areas; or nontypical, one-time tasks in hazardous areas. Deactivation and decommissioning are particularly

amenable to safe work plans because they often involve specialized tasks conducted in a specific area for a defined time.

If not already incorporated into safe work plans and permits, standing orders are used to enforce safe procedures at a worksite and represent practices that must be followed as well as those that must not occur in contaminated areas. A separate set of standing orders should be developed for the CRZ/C and the Exclusion Zone if the hazards are sufficiently different. Example of standing orders include the following:

- No smoking, eating, drinking, or applying of cosmetics in this zone;
- No matches or lighters in this zone;
- Check in at the Access Control Point before you enter this zone; and
- Check out at the Access Control Point before you leave this zone.

7.5 COMPLEXITY OF ACCESS AND HAZARD CONTROLS

As illustrated in Figure 7-2, the site control strategy can become more complex as hazardous waste activities proceed through project milestones. Site control requirements may intensify during deactivation, decommissioning, and remedial phases and become less restrictive during surveillance and maintenance activities and as hazards are remediated and the worksite moves toward closure.

7.6 PERSONAL PROTECTIVE EQUIPMENT

PPE controls the degree of worker exposure. PPE is acceptable as a hazard control measure (1) when engineering or administrative controls are not feasible or do not totally eliminate the hazard, (2) while engineering controls are being developed, or (3) during emergencies. (Note: References listed at the end of this section provide additional and more detailed information on issues such as advantages and disadvantages of PPE, compatibility of various types of PPE with chemical hazards, respiratory protection factors, training and proper fitting, and consideration of work mission duration. Therefore, this information is not repeated here.)

The type of PPE and the material from which the PPE is made are to protect against the hazards present. Worksite managers should be aware that no single combination of protective equipment and clothing can guard against all hazards. Moreover, because every worksite is different and the degree of known or unknown hazards varies, the PPE ensemble required is likely to change as work progresses. For hazardous waste work, PPE is conveniently organized into *levels of protection* under a system originally developed by EPA. There are four levels: A, B, C, and D. Table 7-3 lists the PPE requirements by level. Although each level specifies a complete clothing ensemble, in practice the level of protection selected for a particular task is driven by the respiratory protection requirements; clothing is then matched to the dermal and safety hazards present. OSHA requires that PPE be selected based on three distinct tasks:

- Conduct a hazard characterization and exposure assessment (see Chapter 5) to identify (1) actual or potential hazards and (2) possible exposure routes;
- Organize and analyze the data and select PPE based on the type of hazard, the level of risk, and the seriousness of potential harm from each identified hazard; and
- Make certain that the PPE fits and that it protects against the hazards and periodically reassess the hazards and PPE selection.

Manufacturer's literature is often the best source of information for selecting PPE. However, there are some useful references for hazardous waste work:

- *Guidelines for the Selection of Chemical-Protective Clothing* by J.J. Johnson and A.D. Schwope et al., published by the American Conference of Governmental Industrial Hygienists;
- *Standard Operating Safety Guides*, published by the U.S. EPA Office of Emergency and Remedial Response; and
- *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, published by National Institute for Occupational Safety and Health (NIOSH), OSHA, the U.S. Coast Guard, and U.S. EPA.

Table 7-3. Levels of Protection

LEVEL OF PROTECTION	PPE
A The highest respiratory, skin, and eye protection.	**Required:** • Pressure-demand full-facepiece self-contained breathing apparatus (SCBA) or supplied-air respirator (SAR) • Fully-encapsulating chemical-resistant suit • Inner chemical-resistant gloves • Chemical-resistant safety boots • Disposable glove and boot covers • Coveralls • Hard hat **Recommended:** • Long cotton underwear • Two-way radios • Cooling unit
B The same respiratory and eye protection as Level A, but less skin protection.	**Required:** • Pressure-demand full-facepiece SCBA or SAR • Chemical-resistant clothing • Inner and outer chemical-resistant gloves • Chemical-resistant safety boots • Disposable boot covers • Coveralls • Hard hat **Recommended:** • Long cotton underwear • Two-way radios • Cooling unit
C Hazard-based skin and eye protection, but less respiratory protection than Level B.	**Required:** • Full-facepiece air-purifying respirator (APR) • Chemical-resistant clothing • Inner and outer chemical-resistant gloves • Chemical-resistant safety boots • Disposable boot covers • Coveralls • Hard hat **Recommended:** • Long cotton underwear • Two-way radios
D No respiratory protection. Minimal skin protection.	**Required:** • Coveralls • Abrasion-resistant gloves • Safety boots • Disposable boot covers • Hard hat • Face shield (for flying-debris hazards) • Escape mask

For radiological activities, the *Draft DOE Radiological Control Technical Standard* provides guidance for worksite managers in determining what combination of PPE is to be used. The process is analogous to that used for nonradiological hazards. The radiological control organization is responsible for determining the PPE to be used for work performed under an RWP on a task-by-task basis. Articles 325 and 461 as well as Appendix 3C of the Technical Standard present guidelines for the selection of protective clothing, doffing procedures, and use of step-off pads for contamination control, and warns against the use of PPE beyond that authorized by the radiological control organization because excessive PPE can detract from work performance and be contrary to ALARA principles and waste minimization practices. This is analogous to best practice in nonradiological health and safety hazard control, which also discourages the over-prescription of PPE that can result in problems related to heat stress and worker inefficiency.

Although chemical and radiological PPE requirements are different, they can be applied simultaneously. In some situations where both types of hazards co-exist, chemical issues require the more restrictive level of protection; in others, radiological issues are more restrictive. Successful integration of PPE requirements for mixed wastes or for other combinations of chemical and radiological contaminants requires coordination between radiological and chemical safety professionals and workers. Whatever the circumstances, successfully addressing both types of hazards is essential. As an example, where particulate airborne chemical and radiological hazards exist, the more prescriptive provisions of the *Draft DOE Radiological Control Technical Standard* are followed as the protection specified will protect against both hazards. Where chemical vapors and airborne radiological hazards co-exist, the PPE is marked to ensure proper radiological surveys and decontamination of PPE.

UPGRADING OR DOWNGRADING LEVEL OF PROTECTION

The SSHO and the field team leader are responsible for upgrading or downgrading the level of protection based on provisions specified in the HASP. Clear criteria need to be established based on the guidance outlined in the text box at right.

There are implications of maintaining a higher level of protection than necessary, especially for respiratory protection. Additional requirements are imposed when respiratory protection is specified. The following are considerations in determining the advisability of maintaining a higher level of respiratory protection:

- Working in a respirator can cause unnecessary, potentially dangerous stress to workers;
- Use of respirators limits vision and mobility, particularly when operating heavy equipment;
- Over-reliance on respirators causes a false sense of security as the protection factor for respirators varies with workplace conditions; and
- Implementation of respirator programs is costly.

Upgrading and Downgrading PPE

Upgrading PPE

- Unstable or unpredictable worksite hazards or emissions
- Known or suspected presence of dermal hazards
- Occurrence or likely occurrence of gas or vapor emission
- Change in work task that increases the potential for contact with hazardous materials

Downgrading PPE

- New information that indicates a situation is less hazardous than originally thought
- Hazard assessment and monitoring data show low exposure levels
- Change in site conditions that decreases the hazard
- Change in work task that reduces contact with hazardous materials

If worksite hazards have been minimized through engineering and administrative controls, a management decision to use respirators necessitates implementation of requirements mandated by both 29 CFR 1910.134 and DOE O 440.1. These requirements and the nonmandatory guidance provided in the *Draft DOE Radiological Control Technical Standard* are entirely complementary, with one exception: the *Draft DOE Radiological Control Technical Standard* discourages use of half-facepiece air-purifying respirators. Special requirements for respiratory protection include:

- Preparing a written respiratory protection program, if no written program exists, and appending the new or existing program to the HASP;
- Medically evaluating, training, qualifying, and fit-testing workers for specific respirator types; and
- Checking 29 CFR 1910, Subpart Z, "Toxic and Hazardous Substances," for any special respiratory protection requirements (e.g., for asbestos, lead, or cadmium).

7.7 REFERENCES

10 CFR 20, Appendix A, "Protection Factors for Respirators"

10 CFR 835, "Occupational Radiation Protection"

20 CFR 1910.165, "Employee Alarm Systems"

29 CFR 1910, Subpart I, "Personal Protective Equipment"

29 CFR 1910, Subpart Z, "Toxic and Hazardous Substances,"

29 CFR 1926, "Safety and Health Regulations for Construction"

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan"

DOE 5400.5, "Radiation Protection of the Public and the Environment"

DOE 5480.4, "Environmental Protection, Safety and Health Protection Standards"

DOE O 231.1, CHANGE 001, "Environment, Safety, and Health Reporting"

DOE O 440.1, "Worker Protection Management for DOE Federal and Contractor Employees"

ANSI Z88.2, "Practices for Respiratory Protection"

DOE/EH-0353P, *OSH Technical Reference Manual*

DOE-EM-STD-5503-94, "DOE Limited Standard EM Health and Safety Plan Guidelines"

DOE-STD-1098-96, *Draft DOE Radiological Control Technical Standard*

Forsberg, K. and Mansdorf, S.Z., "Quick Selection Guide to Chemical Protective Clothing"

Johnson, J.J., and Schwope, A.D., et al., *Guidelines for the Selection of Chemical Protective Clothing*

NIOSH/OSHA/USCG/US EPA, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, DHHS Pub. No. 85-115

NIOSH, "Guide to Respiratory Protection"